**Rainbows in Your Stomach**

**Demonstration by Jasmine Chong**

**STUDENT COPY**

Have you ever experienced heartburn after a large meal? Heartburn occurs when gastric acid moves into the esophagus causing a burning sensation in the chest. It is commonly relieved by taking antacids such as TUMS, Milk of Magnesia, or Alka-Seltzer tablets, but have you ever wondered how those antacids really work?

1. **Acids and Bases**
2. Is vinegar an acid or base? ACID BASE

What colour appeared when vinegar was added? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Is NaOH an acid or base? ACID BASE

What colour appeared when NaOH was added? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. **Antacids**
2. What colour appeared when the antacid was added? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. List all the colours that appeared after the vinegar was added. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. **Debrief**
2. Based on your observations, is the antacid an acid or base? ACID BASE
3. What type of reaction was occurring in the beaker when the vinegar was added?

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1. Using your knowledge of the digestive system, explain the importance of taking antacids to relieve heartburn.

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1. **Take It Further**

What would happen if vinegar is continuously added to the solution?

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**Grade Level and Unit:** Grade 11 Biology, Academic and Applied

**Specific Expectations:** E1.2, E2.1, E3.2, E3.4

**Introduction:** This demonstration is a colourful representation of how antacids work to relieve heartburn. Heartburn is caused by the reflux of HCl in the stomach to the esophagus. To relieve the burning sensation, antacids are used to neutralize the acid in the stomach. Prior to this demonstration, students should understand the following:

**Safety:** All chemicals are safe to be disposed of in the tap.

* The mechanisms of acids, bases and pH indicators
* The anatomy and physiology of the digestive organs

**Materials:**

500ml beaker 100ml of vinegar

Magnetic stirrer 50ml of 1M NaOH

Stirring plate 10ml of universal indicator

100ml of milk of magnesia or Mg(OH)2 Tap water

**Procedure:**

1. In the 500ml beaker, pour 10ml of universal indicator and dilute with tap water until the beaker is about half full. Place the magnetic stirrer inside and put the beaker on the stirring plate.
2. Add in the vinegar and observe the solution change to red.
3. Add in the NaOH and observe the solution change to dark blue.
4. Add in 100ml of milk of magnesia and observe the solution change to a milky blue
5. Add some vinegar and observe the rapid colour change from red to orange to yellow to green to blue.

**Results:** The universal indicator changes to a red colour when it detects acids and a dark blue colour when it detects bases. The milk of magnesia is basic and turns blue.

**Explanation:** Upon adding the vinegar, the solution turns red because the acid reacts with a small amount of hydroxide ions from the milk of magnesia. However, as more of the hydroxide ions dissolves, the acid is neutralized and the solution returns to a blue colour. Antacids are efficient at relieving heartburn because its hydroxide ions combine with the hydrogen ions in HCl to calm overactivity in the stomach.

**Tips:** Show the colour change a few more times by adding small amounts of vinegar into the solution. If a stirring plate or magnetic stirrer is not available, consider asking a volunteer to help stir the solution.

**Reference:** Steve Spangler Science. (2012). Color Changing Milk of Magnesia. Adapted from: http://www.stevespanglerscience.com/experiment/color-changing-milk-of-magnesia.